REMARKS

The Examiner has rejected claims 54 and 58 under 35 U.S.C. §112, second paragraph. Claims 1, 35, 92, 94 and 95 are rejected under 35 U.S.C. §102(b) as being anticipated by Yao et al. U.S. Patent No. 6,051,114 (hereinafter "Yao"). Claims 43-59, 61, 62 and 84 are rejected under 35 U.S.C. §102(b) as being anticipated by Yasar et al. U.S. Patent Application Publication No. 2003/0034244 (hereinafter "Yasar"). Claims 2-11, 13-28, 30-33, 36-42 and 93 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar. Claims 12 and 29 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar, as applied to claims 2-11, 13-28, 30-33 and 36-42 and 93 above, and further in view of Konishi et al. Japanese Patent No. 09-360040 (hereinafter "Konishi"). Claim 34 is rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar, as applied to claims 2-11, 13-28, 30-33 and 36-42 and 93 above, and further in view of Gopalraja et al. U.S. Patent No. 6,274,008 (hereinafter "Gopalraja"). Claims 64-79, 81-83 and 85-91 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar in view of Yao. Claims 60 and 80 are rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar in view of Yao, as applied to claims 64-79 and 81-91 above, and further in view of Konishi. Claim 63 is rejected under 35 U.S.C. §103(a) as being unpatentable over Yasar in view of Yao, as applied to claims 64-79 and 81-91 above, and further in view of Gopalraja. The following remarks are respectfully submitted.

35 U.S.C. §112

The claims as amended should cure the Examiner's rejection under 35 U.S.C. §112, second paragraph, for being indefinite and failing to particularly point out and distinctly claim the subject matter of claims 54 and 58. Specifically, there is now proper antecedent basis for NND.

The Invention and the References

While both the invention and the cited Yasar and Yao references combine the effects of iPVD (deposition) and etching to reduce overhangs when coating high aspect ratio features in semiconductor processing, both references rely on SEQUENTIAL deposition and etch steps to achieve this result, while the invention provides a NET deposition rate by balancing the deposition and etching that occur SIMULTANEOUSLY in a plasma processing step. The sequential dep/etch process of Yasar is discussed in paragraphs [0020]-[0021] of the application. The sequential process of Yao is apparent from Figs. 2 and 4 of Yao and the accompanying description. Applicants' LND and NND process steps, on the other hand, involve an ultra low deposition RATE, which is defined as a rate of not more than approximately 30 nanometers per minute. The LND process involves a low net deposition rate on the field areas of the substrate, while an NND process involves essentially no net deposition (defined as approximately between –10 and +10 nanometers/minute) on the field areas of the substrate.

Applicants have amended the claims to clarify the difference set forth above, as explained further in the remarks below. Specific parameter settings that produce the claimed LND and NND process steps are set forth in the dependent claims as explained in the specification.

35 U.S.C. §102

The Examiner has rejected claims 1, 35, 92, 94 and 95 as being anticipated by the teachings of Yao. Applicants respectfully submit that the Examiner is incorrect in this rejection.

Applicants' amended claim 1 now states, in part, a process step that includes:

> depositing material onto the field area at a deposition rate of not more than 30 nanometers per minute (nm/min) while depositing or etching material, or a combination thereof, on the sidewall or the bottom surface, or a combination thereof and thereby producing substantially no overhanging material at feature openings

Applicants' amended claim 92 recites a similar subject matter by stating, in part:

> exposing the patterned substrate to the high-density plasma that includes coating material and gas ions and performing therewith on the substrate an ionized physical vapor deposition process while controlling parameters of the iPVD system to simultaneously coat and etch the substrate so as to thereby establish a net deposition rate of not more than approximately 30 nanometers per minute onto the field area of the substrate while material is deposited on the sidewall or bottom surface, or a combination thereof

Herein the processes are claimed according to the manner by which material is deposited on the field area while material is deposited or etched on the sidewall and/or the bottom surface of the feature. (Applicants FIG. 9; ¶¶0024, 0053, 0114, 0118, 0130, 0132). That is, the dep-etch is simultaneous. It is this simultaneous dep-etch process that produces substantially no overhanging material by controlling the rate of deposition on the field area to not more than 30 nm/min – not merely eliminate the overhang after a large deposition process. (Applicants claim 1). This is significant because Applicants specifically critiqued the sequential dep-etch processes as taught in the prior art for "not fundamentally control[ing]" the deposition step of the process and allowing the excessive buildup of overhang thus requiring a subsequent etch routine. (Applicants ¶¶0020-21).

Yao utilizes a pulse DC power supply to reduce the sticking of metal ions to the field area of the substrate while material is deposited onto the walls of the trench or the hole. (Yao Col. 5, Lines 44-Col. 6, Line 2). This allows the hole of the trench to become filled with the deposited material while preventing the deposition of metal on the field areas. (*Id*). However, the Yao process is sequential as illustrated in Yao's FIG. 2. Here it is readily seen that a high negative potential 200 is applied to the target to accelerate deposition flux toward the substrate for depositing on the field and within the hole or trench and a slightly positive voltage 202 to remove charge buildup. (Yao FIG. 2; Col. 4, Lines 19-45). This slightly positive voltage creates an intermittent etching of the field area. (Yao Col. 6, Lines 12-26).

Thus, Yao does not teach a simultaneous dep-etch process including the depositing

of a material in the field area while depositing or etching, or combination thereof, in the sidewall or bottom surface of a feature as in Applicants' claims 1 and 92. It is for at least these reasons that Applicants respectfully submit that independent claims 1 and 92 are now allowable over Yao. Further, as claim 35 depends upon independent claim 1 and claims 94 and 95 depend upon independent claim 92, and therefore recite all of the elements therein, Applicants further submit that these dependent claims are also allowable over Yao.

The Examiner then rejected claims 43-59, 61, 62 and 84 as being anticipated by Yasar. Of these rejected claims, independent claim 43 now recites in part:

> the NND deposition rate comprising deposition rate on the field area of the substrate that is not more than –10 nanometers per minute (nm/min) and not greater than +10 nanometers per minute (nm/min)

Again, Applicants' independent claim 43 is claiming a process whereby deposition and etching are simultaneously performed and the deposition of material onto the field area is tightly controlled. One difference in the NND process as compared to the LND process is the location of the deposition with respect to the locations of the dep-etch. In the NND process, there is a "no net deposition" rate on the field area and bottom surface of the feature while deposition simultaneously occurs on the sidewalls of the feature. (Applicants FIG. 12; ¶0077, 0149). In LND, the deposition was on the field area.

Yasar, like Yao, teaches a sequential dep-etch process (Yasar Fig. 4). The differences in Yasar's dep-etch processing being (1) there is a change in chamber pressure with the changing dep-etch routine and (2) the etch process time is not intermittent. (Yasar FIG. 4-5B, ¶0035). It is this combination of sequential dep-etch with its corresponding and alternating high and low pressures that creates a good sidewall and bottom coverage of the via or trench by etching away the uncontrolled overhang deposition. (Yasar ¶¶0005, 0011).

Therefore, Yasar does not teach the depositing of a material on the sidewall of a

via or trench while depositing or etching or a combination thereof on the field and bottom surfaces of the substrate. It is for at least this reason Applicants respectfully submit that independent claim 43 is allowable over the teachings of Yasar. Further, as claims 44-59, 61, 62 and 84 ultimately depend on independent claim 43 and recite all of the elements therein, these dependent claims are also allowable over the teachings of Yasar.

35 U.S.C. §103

Claims 2-11, 13-28, 30-33 and 36-42 and 93 were rejected as being unpatentable over the teachings of Yao in view of Yasar. Of these rejected claims, claim 93 ultimately depends on independent claim 92. The remaining claims ultimately depend on independent claim 1. For the reasons stated above, these dependent claims should be considered allowable because the independent claims on which they respectfully depend are allowable over the teachings of Yao. However, for purposes of completeness, Applicants will address the combined teachings of Yao with Yasar.

The Examiner notes several deficiencies in the teachings of Yao and provides a listing of these deficiencies in pages 6 and 7 of the Office Action dated January 9, 2008. These deficiencies generally relate to operational parameters and chemical. However, in attempting to cure these deficiencies, the Examiner has not cited to art that teaches an LND deposition process as claimed by Applicants. Rather, the Examiner cites to Yao and Yasar, which teach sequential dep-etch processes described in detail above. It is for at least these reasons that Applicants submit that these dependent claims remain allowable over the combination of Yao and Yasar.

Dependent claims 12 and 29 were rejected under 35 U.S.C. 103(a) as being unpatentable over the teachings of Yao in view of Yasar and further in view of Konishi. In that regard, the Examiner has noted that the combination of Yao and Yasar does not teach the use of a metal gas. (Office Action dated January 9, 2008, page 11). While the Examiner is correct in asserting that Konishi teaches the use of an organometallic gas in the formation of a membrane

during the CVD process, Konishi does not cure the deficiencies in the teachings of Yao and Yasar. (Konishi ¶[0033, machine translation). Specifically, this combination of art does not teach an LND process according to claim 1. Therefore, Applicants submit that claims 12 and 29 are allowable over the combination of art.

Claim 34 was rejected under 35 U.S.C. §103(a) as being unpatentable over Yao in view of Yasar and further in view of Gopalraja. In that regard, the Examiner asserts that Gopalraja teaches punching through the bottom layer by etching through the barrier layer at the via bottom, which was not addressed in either Yao or Yasar. (Office Action dated January 9, 2008, page 11). However, Gopalraja does not teach an LND process including depositing material in the field area while depositing or etching material on the sidewall or the bottom surface or a combination thereof. Therefore, Applicants submit that claim 34 is allowable over this combination of art.

Claims 64-79, 81-83 and 85-91 were rejected under 35 U.S.C. §103(a) as being unpatentable over the combined teachings of Yasar in view of Yao. These claims are dependent on independent claim 43 and should be allowable for at least the reasons that claim 43 is considered allowable. However, Applicants will address these claims in view of the combination of cited art for completeness.

The Examiner notes several deficiences in the teachings of Yasar, including the changing of a NND to an LND process. (Office Action dated Janurary 9, 2008, pages 12 and 13). Yet, Yao fails to teach either process, as was described in detail above. It is for at least these reasons that Applicants submit that these dependent claims remain allowable over the combination of art.

The Examiner then rejects claims 60 and 80 under 35 U.S.C. §103(a) as being unpatentable over the combined teachings of Yasar, Yao and Konishi. As noted above, Konishi does teach the use of an organometallic gas during the CVD process, but does not cure the deficiencies of Yasar and Yao by teaching an NND process. Therefore claims 60 and 80 should

be considered allowable over this cited combination of art.

Finally, the Examiner rejects claim 63 under 35 U.S.C. §103(a) as being unpatentable over the combined teachings of Yasar, Yao and Gopalraja. Again, Applicants submit that Gopalraja does not cure the deficiencies of Yasar and Yao for the same reasons as noted above. Specifically Gopalraja does teach an NND process. Thus, claim 63 should be considered allowable over the combination of Yasar, Yao and Gopalraja.

In view of the foregoing amendments to the claims and remarks given herein, Applicants respectfully believe this case is in condition for allowance and respectfully request allowance of the pending claims. If the Examiner believes any detailed language of the claims requires further discussion, the Examiner is respectfully asked to telephone the undersigned attorney so that the matter may be promptly resolved. The Examiner's prompt attention to this matter is appreciated.

Applicants are of the opinion that a one-month extension of time is due with this Amendment. Payment of all charges due for this filing is made on the attached Electronic Fee Sheet. If any additional charges or credits are necessary to complete this communication, please apply them to Deposit Account No. 23-3000.

Respectfully submitted,

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